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Approval

Customer : _____ **DATE : Feb. 20. 2012**

SAMSUNG TFT-LCD

MODEL : **LTI460HN04**

Any Modification of Specification is not allowed without SEC's Permission.

NOTE :

Customer's *Approval*	
SIGNATURE	DATE

APPROVED BY	DATE
Heo Jeongmin	Feb.20.2012
PREPARED BY	DATE
ChangHee Hong	Feb.20.2012

Application Engineering Part, LCD Business

Samsung Electronics Co . , LTD.

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* Revision History

Date	Rev. No	Page	Summary
Feb, 20 2012	000	all	-First issued

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General Description

Description

LTI460HN04 is a color active matrix liquid crystal display (LCD) that uses amorphous silicon TFT(Thin Film Transistor) as switching components. This model is composed of a TFT LCD panel, a driver circuit and a backlight unit. The resolution of a 46.0" is 1920 x 1080 and this model can display up to 16.7 million colors with wide viewing angle of 89° or higher in all directions. This panel is intended to support applications to provide a excellent performance for Flat Panel Display such as Home-alone Multimedia TFT-LCD TV, Display terminals for AV application products, and Digital Information Display (DID).

Features

- RoHS compliance (Pb-free)
- High contrast ratio, High luminance
- SVA(Super Vertical Align) mode
- Wide viewing angle (±178°)
- High speed response
- Landscape / Portrait type compatible
- Wide UXGA (1920 x 1080 pixels) resolution (16:9)
- Low power consumption
- Direct Type 12 CCFLs(Cold Cathode Fluorescent Lamp)
- DE(Data Enable) mode
- LVDS (Low Voltage Differential Signaling) interface (2pixel/clock)
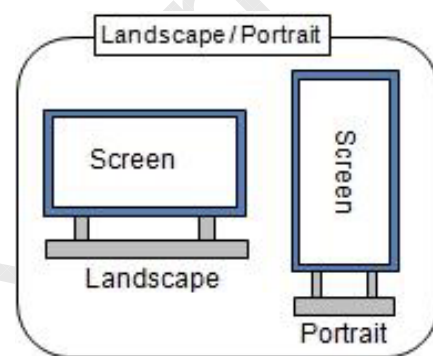
General Information

Items	Specification	Unit	Note
Module Size	$1083.0(W_{TYP})$ x $627.0(H_{TYP})$	mm	± 1.0 mm
	59.0(DTyp)		± 1.0 mm
Weight	12,500	g	Max
Pixel Pitch	0.53025(H) x 0.53025(V)	mm	
Active Display Area	1018.08(H) x 572.67(V)	mm	
Surface Treatment	Haze 44% , Hard-coating (3H)		
Display Colors	8 bit - 16.7M	colors	
Number of Pixels	1920 x 1080	pixel	
Pixel Arrangement	RGB vertical stripe		
Display Mode	Normally Black		
Luminance of White	450 (Typ.)	cd/m^2	

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1. Absolute Maximum Ratings

If the condition exceeds maximum ratings, it can cause malfunction or unrecoverable damage to the device.

Item		Symbol		Min.	Max.	Unit	Note
Power Supply Voltage		V_{DD}		GND-0.5	13.2	V	(1)
Storage temperature		T_{STG}		-20	65	℃	(2)
Glass surface temperature (Operation)	Center	T_{CENTER}		0	50	℃	(2),(5)
		T_{SUR}		0	65	℃	
Shock (Non-operating)		S_{nop}	x,y	-	40	G	(3)
			z	-	30		
Vibration (Non-operating)		V_{nop}		-	1.5	G	(4)

Note (1) Ta= 25 $\pm$ 2 °C

(2) Temperature and relative humidity range are shown in the figure below.
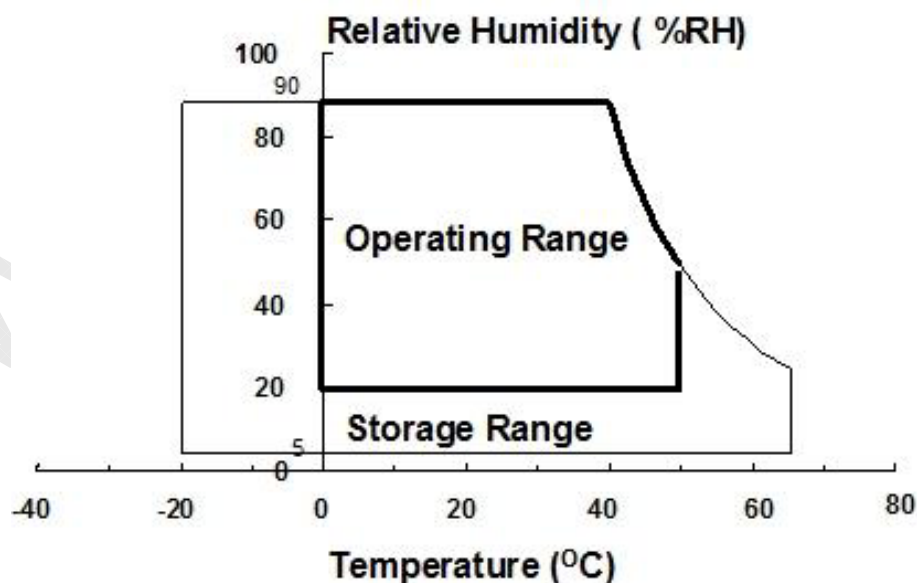   a. 90 % RH Max. (Ta $\leq$ 39 °C)
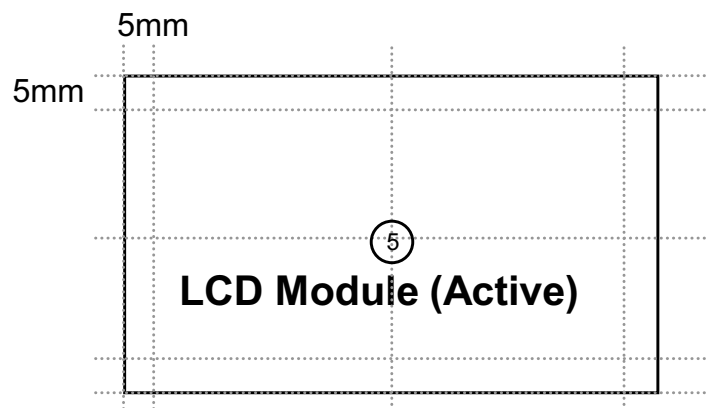   b. Relative Humidity is 90% or less. (Ta > 39 °C)
   c. No condensation

(3) 11ms, Sine wave, one time for $\pm$X, $\pm$Y, $\pm$Z axis

(4) 10-300Hz, Sweep rate 10min, 30min for X,Y,Z axis

Relative Humidity (%RH)

Operating Range

Storage Range

Temperature (^{O}C)

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(5) Definition of test point

5mm

5mm

⑤

LCD Module (Active)

T_{CENTER} : Temperature of the center of the glass surface (Test point 5)

2. Application information for DID (Digital Information Display)

A long-term display like DID application may cause uneven display including image retention.
To optimize module's lifetime and function, several operating usages are required.

1. Normal operating condition
   - Temperature: 20 ± 15℃
   - Humidity: 55 ± 20 %
   - Display pattern: moving picture or regular switchover display
Note) Long-term static information image may cause uneven display.

2. Operating usages under abnormal operating condition. Note (1)
   a. Ambient condition
    - Well-ventilated place is recommended to set up DID system.
   b. Power off and screen saver
    - Periodical power-off or screen saver is needed after long-term static display. Note (2)

3. Operating usages to protect uneven display due to long-term static information display
   a. Suitable operating time for B-DID : under 12 hours a day.
   b. Periodical display contents change from static image to moving picture.
    - Liquid crystal refresh time is required.
   c. Periodical background color and character (image) color change
    - Use different colors for background and character (image), respectively.
    - Change colors periodically.
   d. Avoid combination of background and character with large different luminance.

Note (1) Abnormal condition means every operating condition except normal operating condition.
Note (2) Moving picture or black pattern is strongly recommended for screen saver.

4. Lifetime in this spec is guaranteed only when DID is used under right operating usages.

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3. Optical Characteristics

The optical characteristics should be measured in a dark room or equivalent.
Measuring equipment : TOPCON BM-7,SPECTRORADIOMETER SR-3

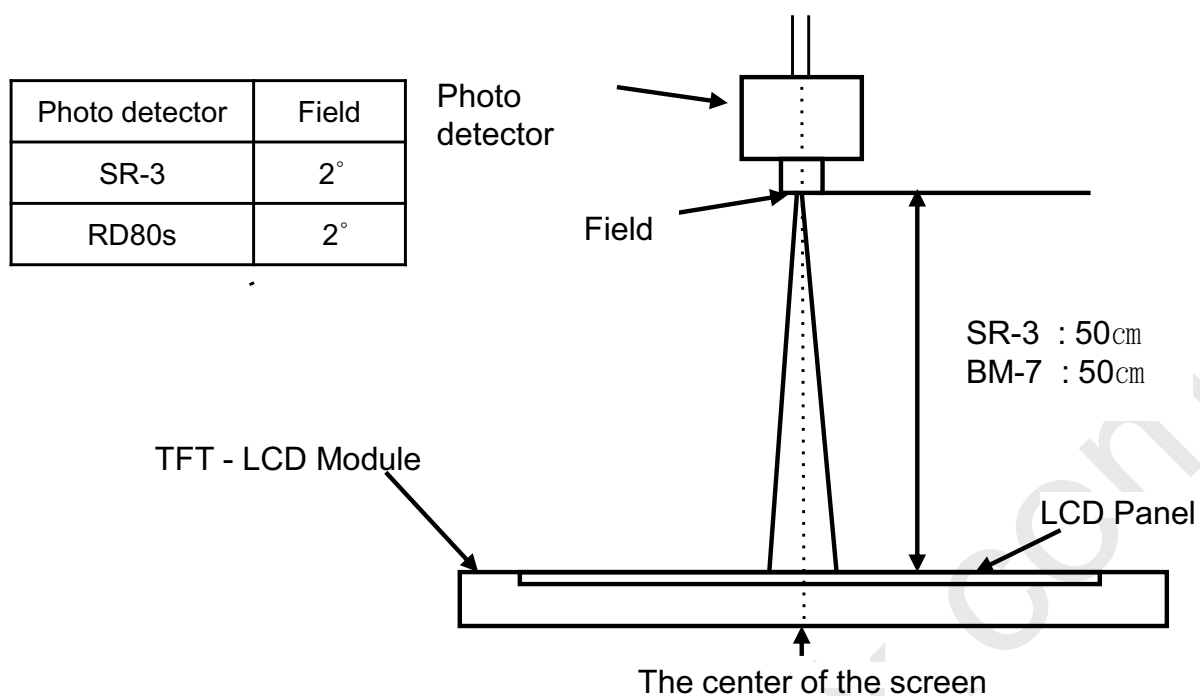(Ta = 25 ± 2°C, V_{DD} = 12V, f_V = 60Hz, f_{DCLK} = 148.5 MHz, I_L = 14mArms)

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio (Center of screen)		C/R		2000	3000	-		(3) SR-3
Response Time	G-to-G	Tg		-	8	16	msec	(5) BM-7
Luminance of White (Center of screen)		Y_L		400	450	-	cd/m²	(6) SR-3
Color Chromaticity (CIE 1931)	Red	Rx	Normal $\theta L,R$=0 $\theta U,D$=0 Viewing Angle	TYP. -0.03	0.640	TYP. +0.03		(7),(8) SR-3
		Ry			0.330			
	Green	Gx			0.300			
		Gy			0.600			
	Blue	Bx			0.150			
		By			0.060			
	White	Wx			0.280			
		Wy			0.290			
Color Gamut		-		-	72	-	%	(7) SR-3
Color Temperature		-		-	10000	-	K	(7) SR-3
Viewing Angle	Hor.	θ_L	C/R≥10	75	89	-	Degree	(8) SR-3
		θ_R		75	89	-		
	Ver.	θ_U		75	89	-		
		θ_D		75	89	-		
Brightness Uniformity (9 Points)		B_{uni}		-	-	25	%	(4) SR-3

Note (1) Test Equipment Setup

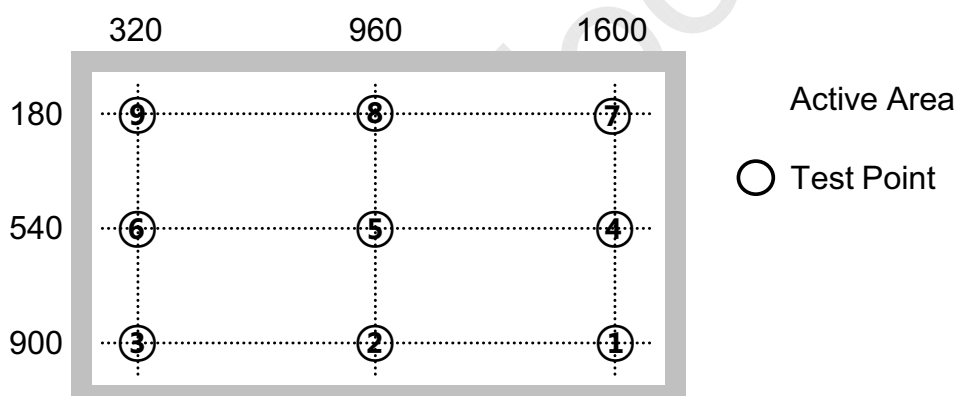The measurement should be executed in a stable, windless and dark room between 40min and 60min after lighting the backlight at the given temperature for stabilization of the backlight. This should be measured in the center of screen.

Single lamp current : 14.0 mA
Environment condition : Ta = 25 ± 2 °C

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Photo detector	Field
SR-3	2°
RD80s	2°

Photo detector

Field

SR-3 : 50㎝
BM-7 : 50㎝

TFT - LCD Module

LCD Panel

The center of the screen

Note (2) Definition of test point

	320	960	1600
180	⑨	⑧	⑦
540	⑥	⑤	④
900	③	②	①

Active Area

○ Test Point

Note (3) Definition of Contrast Ratio (C/R)
: Ratio of gray max (Gmax) & gray min (Gmin) at the center point ⑤ of the panel

$$C/R = \frac{G\max}{G\min}$$

Gmax : Luminance with all pixels white
Gmin : Luminance with all pixels black

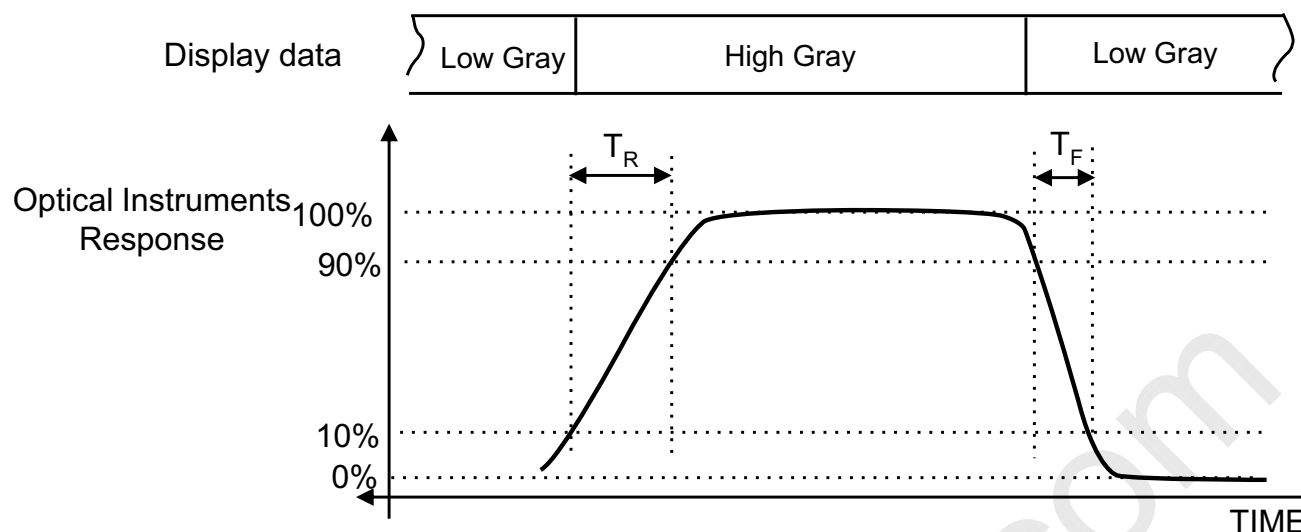Note (4) Definition of 9 points brightness uniformity

$$Buni = 100 * \frac{(B\max - B\min)}{B\max}$$

Bmax : Maximum brightness
Bmin : Minimum brightness

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Note (5) Definition of Response time : Average response time of all Gray to Gray

Display data: Low Gray | High Gray | Low Gray

Optical Instruments Response

T_R ... T_F

100%
90%
10%
0%

TIME

Gray to Gray Response Time										
	Gray	**End**								
		0	31	63	95	127	159	191	223	255
Start	**0**		Tr(0−31)	Tr(0−63)	Tr(0−95)	Tr(0−127)	Tr(0−159)	Tr(0−191)	Tr(0−223)	Tr(0−255)
	31	Tf(31−0)		Tr(31−63)	Tr(31−95)	Tr(31−127)	Tr(31−159)	Tr(31−191)	Tr(31−223)	Tr(31−255)
	63	Tf(63−0)	Tf(63−31)		Tr(63−95)	Tr(63−127)	Tr(63−159)	Tr(63−191)	Tr(63−223)	Tr(63−255)
	95	Tf(95−0)	Tf(95−31)	Tf(95−63)		Tr(95−127)	Tr(95−159)	Tr(95−191)	Tr(95−223)	Tr(95−255)
	127	Tf(127−0)	Tf(127−31)	Tf(127−63)	Tf(127−95)		Tr(127−159)	Tr(127−191)	Tr(127−223)	Tr(127−255)
	159	Tf(159−0)	Tf(159−31)	Tf(159−63)	Tf(159−95)	Tf(159−127)		Tr(159−191)	Tr(159−223)	Tr(159−255)
	191	Tf(191−0)	Tf(191−31)	Tf(191−63)	Tf(191−95)	Tf(191−127)	Tf(191−159)		Tr(191−223)	Tr(191−255)
	223	Tf(223−0)	Tf(223−31)	Tf(223−63)	Tf(223−95)	Tf(223−127)	Tf(223−159)	Tf(223−191)		Tr(223−255)
	255	Tf(255−0)	Tf(255−31)	Tf(255−63)	Tf(255−95)	Tf(255−127)	Tf(255−159)	Tf(255−191)	Tf(255−223)	

Ton / Toff

T*(X-Y) : Response time from level of gray(X) to level of gray(Y)

Response time Definition $= \Sigma \, [T*(X-Y)] / 72$

Note (6) Definition of Luminance of White : Luminance of white at center point ⑤

Note (7) Definition of Color Chromaticity (CIE 1931)
Color coordinate of Red, Green, Blue & White at center point ⑤

Note (8) Definition of Viewing Angle
: Viewing angle range (C/R ≥ 10)

θ_U θ_R θ_L θ_D

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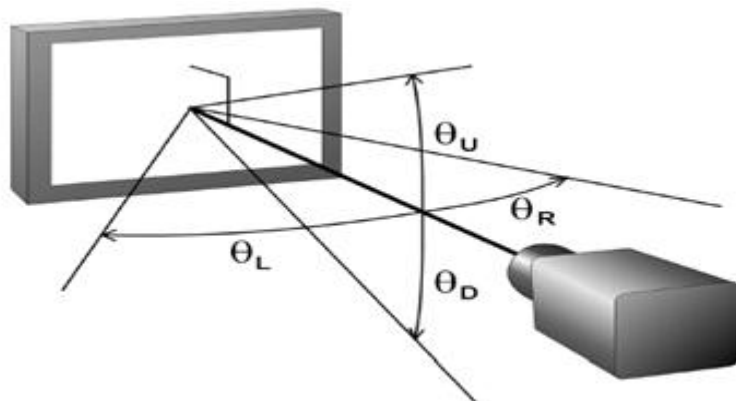
4. Electrical Characteristics

4.1 TFT LCD Module
The connector for display data & timing signal should be connected.

Ta = 25°C ± 2 °C

Item		Symbol	Min.	Typ.	Max.	Unit	Note
Voltage of Power Supply		V_{DD}	10.8	12.0	13.2	V	(1)
Current of Power Supply	(a) Black	I_{DD}	-	600	800	mA	(2),(3)
	(b) White		-	1200	1400	mA	
	(c) Checker		-	800	1000	mA	
Vsync Frequency		f_V	48	60.0	62	Hz	
Hsync Frequency		f_H	54	67.5	69.75	kHz	
Main Frequency		f_{DCLK}	118.8	148.5	153.45	MHz	
Rush Current		I_{RUSH}	-	-	3.0	A	(4)

Note (1) The ripple voltage should be controlled under 10% of V_{DD}.
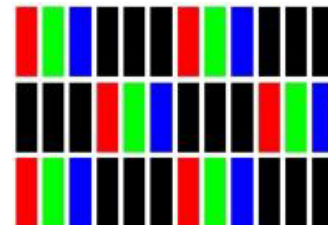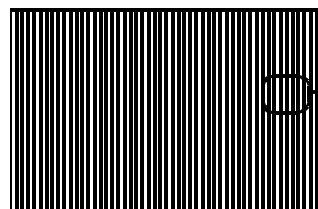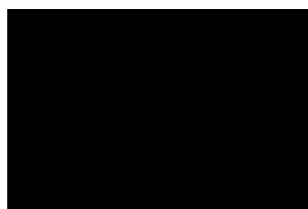 (2) f_V = 60Hz, f_{DCLK} = 148.5MHz, V_{DD} = 12.0V, DC Current.
  (3) Power dissipation check pattern (LCD Module only)

a) Black Pattern   b) White Pattern   c) Checker

(4) Measurement Conditions

T_{RUSH}=470μs
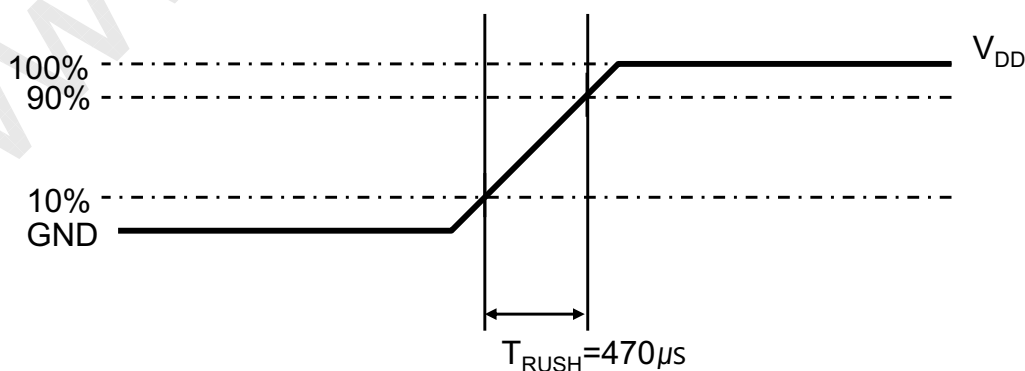
Rush Current I_{RUSH} can be measured when T_{RUSH}. is 470μs.

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4.2 Back Light Unit

The backlight unit contains 12 direct-lighting type CCFTs (Cold Cathode Fluorescent Tube). The characteristics of lamps are shown in the following tables.

Ta=25 $\pm$ 2°C

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Lamp Current	I_L	11.0	14.0	15.0	mArms	
Lamp Voltage	V_L	935	965	995	Vrms	
Operating Life Time	Hr	50,000	-	-	Hour	(1)

Note (1) It is defined as the time to take until the brightness reduces to 50% of its original value.

[Operating condition : Ta = 25$\pm$2℃, IL = 14.0 mArms, For single lamp only]

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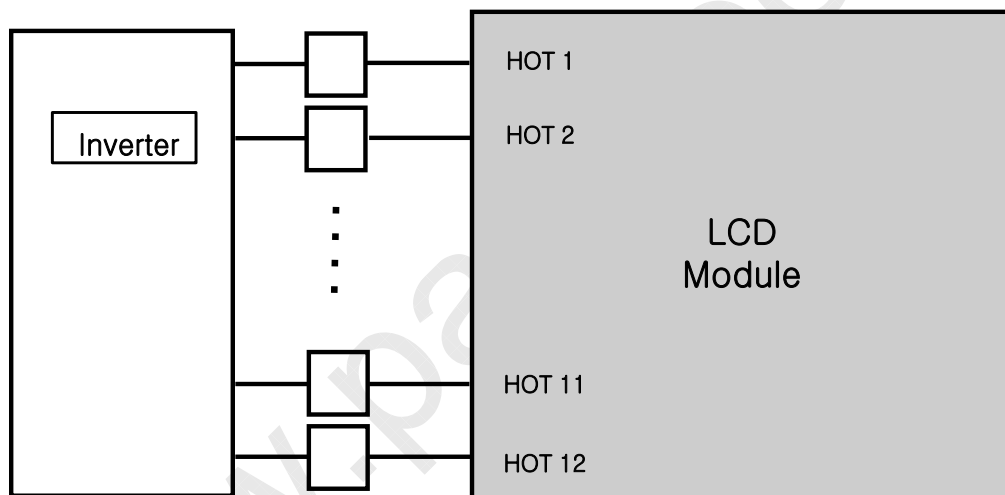
4.3 Inverter input condition & Specification

Items	Symbol	Conditions	Specifications			Unit	Note
			Min.	Typ.	Max.		
Input Voltage	Vin	-	21.6	24	26.4	V	Ta=25±2 °C
Input Current	Iin	Vin = 24.0V Vdim = 3.3V	-	-	9.09	Adc	Initial turn on
Output Current	$I_{O,MAX}$	Vdim = 3.3V	13.3	14.0	14.7	mArms	After 1 hour Warm-up(1)
Backlight On/Off	ON	Vin = 24.0V	2.4	-	5.25	V	-
	OFF	Vin = 24.0V	0	-	0.8		
Dimming Control	ON	Max	3.3	-		V	(2)
	OFF	Min		-	0		

Note (1) Power Consumption is measured at 450[cd/m2] of luminance condition which is

the typical luminance value.

(2) Internal Dimming
- Analog DC Voltage 0 V : Minimum Duty
- Analog DC Voltage 3.3 V : Maximum Duty

※ Additional Appendix for supply current

Items	Symbol	Conditions	Specifications			Unit
			Min.	Typ.	Max.	
Input Current	$I_{IN\_overshoot}$	V_{IN}=24V, DIM=3.3V (Within 1hr at BLU ON)	-	7.78	8.30	Adc
	$I_{IN\_saturation}$	V_{IN}=24V, DIM=3.3V (After 1hr Aging)	-	6.75	7.20	

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5. Input Terminal Pin Assignment

5.1 Input Signal & Power

Connector : FI-RE51S-HF (JAE)

PIN No.	Description		PIN No.	Description	
1	Vdd (12V)		26		RE[0]P
2	Vdd (12V)		27		RE[1]N
3	Vdd (12V)		28		RE[1]P
4	Vdd (12V)		29		RE[2]N
5	Vdd (12V)		30		RE[2]P
6	No Connection(1)		31	Even LVDS Signal	GND
7	GND		32		RECLK-
8	GND		33		RECLK+
9	GND		34		GND
10		RO[0]N	35		RE[3]N
11		RO[0]P	36		RE[3]P
12		RO[1]N	37		No Connection(1)
13		RO[1]P	38		No Connection(1)
14		RO[2]N	39	GND	
15		RO[2]P	40	No Connection (1)	
16	Odd LVDS Signal	GND	41	No Connection(1)	
17		ROCLK-	42	No Connection (1)	
18		ROCLK+	43	No Connection(1)	
19		GND	44	No Connection (1)	
20		RO[3]N	45	LVDS_SEL (2)	
21		RO[3]P	46	No Connection(1)	
22		No Connection(1)	47	No Connection(1)	
23		No Connection(1)	48	No Connection(1)	
24	GND		49	No Connection (1)	
25	Even LVDS	RE[0]N	50	No Connection(1)	
			51	No Connection (1)	

Note 1) No Connection : These pins are only used for SAMSUNG internal purpose.
Note 2) LVDS OPTION : IF THIS PIN : HIGH (3.3 V) → NORMAL NS LVDS FORMAT
              OTHERWISE : LOW (GND) OR OPEN(NC) → JEIDA LVDS FORMAT
     Sequence : On = V_{DD}(T1) ≥ LVDS Option ≥ Interface Signal(T2)
               OFF = Interface Signal(T3) ≥ LVDS Option ≥ V_{DD}

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Note (3) LVDS Connector

PCB

▼

Pin No. 1   Pin No. 51

#1   #51

#1   #51
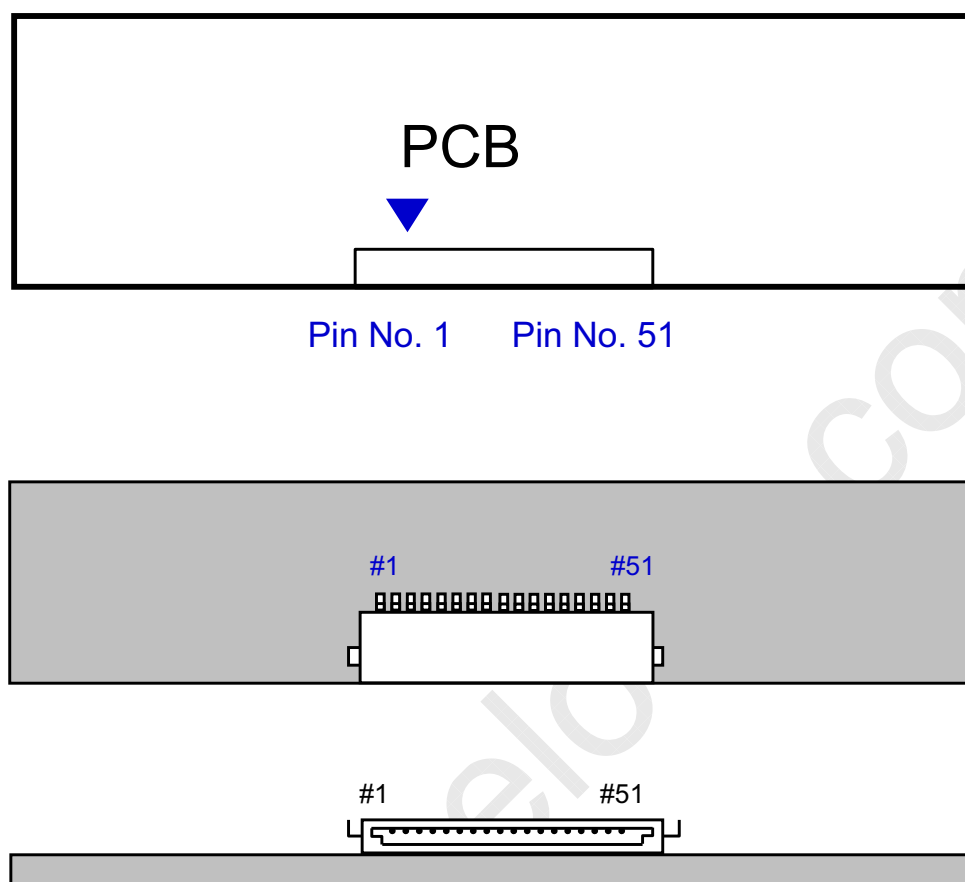
Fig. Connector diagram

a. All GND pins should be connected together and also be connected to the LCD's metal chassis.
b. All power input pins should be connected together.
c. All N.C pins should be separated from other signal or power.

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5.2 Inverter input Pin Configuration

22022WR-014B1 (YEONHO)

Pin No.	Pin Configuration(FUNCTION)
1	Vin (24V)
2	Vin (24V)
3	Vin (24V)
4	Vin (24V)
5	Vin (24V)
6	GND
7	GND
8	GND
9	GND
10	GND
11	No Connection
12	ENA (Inverter on/off Control signal) DC 0 to 0.8V off, DC 2.4 to 5.25V On
13	Internal Dimming control [0V: Min, 3.3V: Max]
14	No Connection

5.3 Inverter Input Power Sequence

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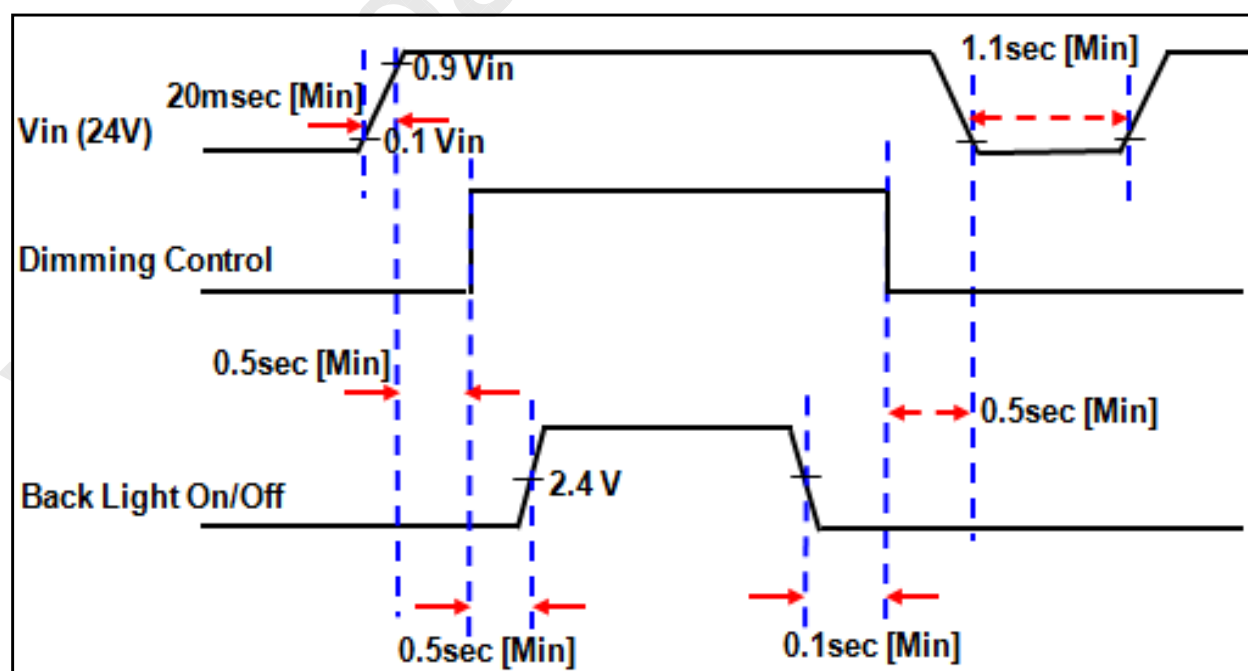
5.4 LVDS Interface
- LVDS Receiver : Tcon (merged)
- Data Format (JEIDA & Normal)

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Default LVDS Option : JEIDA

	LVDS pin	JEIDA -DATA	VESA -DATA
TxOUT/RxIN0	TxIN/RxOUT0	R2	R0
	TxIN/RxOUT1	R3	R1
	TxIN/RxOUT2	R4	R2
	TxIN/RxOUT3	R5	R3
	TxIN/RxOUT4	R6	R4
	TxIN/RxOUT6	R7	R5
	TxIN/RxOUT7	G2	G0
TxOUT/RxIN1	TxIN/RxOUT8	G3	G1
	TxIN/RxOUT9	G4	G2
	TxIN/RxOUT12	G5	G3
	TxIN/RxOUT13	G6	G4
	TxIN/RxOUT14	G7	G5
	TxIN/RxOUT15	B2	B0
	TxIN/RxOUT18	B3	B1
TxOUT/RxIN2	TxIN/RxOUT19	B4	B2
	TxIN/RxOUT20	B5	B3
	TxIN/RxOUT21	B6	B4
	TxIN/RxOUT22	B7	B5
	TxIN/RxOUT24	HSYNC	HSYNC
	TxIN/RxOUT25	VSYNC	VSYNC
	TxIN/RxOUT26	DEN	DEN
TxOUT/RxIN3	TxIN/RxOUT27	R0	R6
	TxIN/RxOUT5	R1	R7
	TxIN/RxOUT10	G0	G6
	TxIN/RxOUT11	G1	G7
	TxIN/RxOUT16	B0	B6
	TxIN/RxOUT17	B1	B7
	TxIN/RxOUT23	RESERVED	RESERVED

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5.5 Input Signals, Basic Display Colors and Gray Scale of Each Color

COLOR	DISPLAY (8bit)	RED								GREEN								BLUE								GRAY SCALE LEVEL
		R0	R1	R2	R3	R4	R5	R6	R7	G0	G1	G2	G3	G4	G5	G6	G7	B0	B1	B2	B3	B4	B5	B6	B7	
BASIC COLOR	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	-
	GREEN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	-
	CYAN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
	RED	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	MAGENTA	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	-
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	-
	WHITE	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
GRAY SCALE OF RED	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R0
	DARK ↑	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1
		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R2
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	R3~ R252
	↓ LIGHT	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
		1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R253
		0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R254
	RED	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R255
GRAY SCALE OF GREEN	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G0
	DARK ↑	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G1
		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G2
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	G3~ G252
	↓ LIGHT	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
		0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	G253
		0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	G254
	GREEN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	G255
GRAY SCALE OF BLUE	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B0
	DARK ↑	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	B1
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	B2
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	B3~ B252
	↓ LIGHT	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	B253
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	B254
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	B255

Note) Definition of Gray :

    Rn : Red Gray, Gn : Green Gray, Bn : Blue Gray (n = Gray level)

    Input Signal : 0 = Low level voltage, 1 = High level voltage

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6. Interface Timing

6.1 Timing Parameters (DE mode)

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
Clock	Frequency	$1/T_C$	130	148.5	160	MHz	-
Hsync	Frequency	F_H	48.0	67.5	72.0	KHz	-
Vsync	Frequency	F_V	48	60	62	Hz	-
Vertical Display Term	Active Display Period	T_{VD}	-	1080	-	Lines	-
Vertical Display Term	Vertical Total	T_V	1092	1125	1158	Lines	-
Horizontal Display Term	Active Display Period	T_{HD}	-	1920	-	Clocks	-
Horizontal Display Term	Horizontal Total	T_H	2090	2200	2350	Clocks	-

Note) This product is DE mode. And, the input of Hsync & Vsync signal does not
       have an impart on normal operation.
     Test Point : TTL control signal and CLK at LVDS Tx input terminal in system

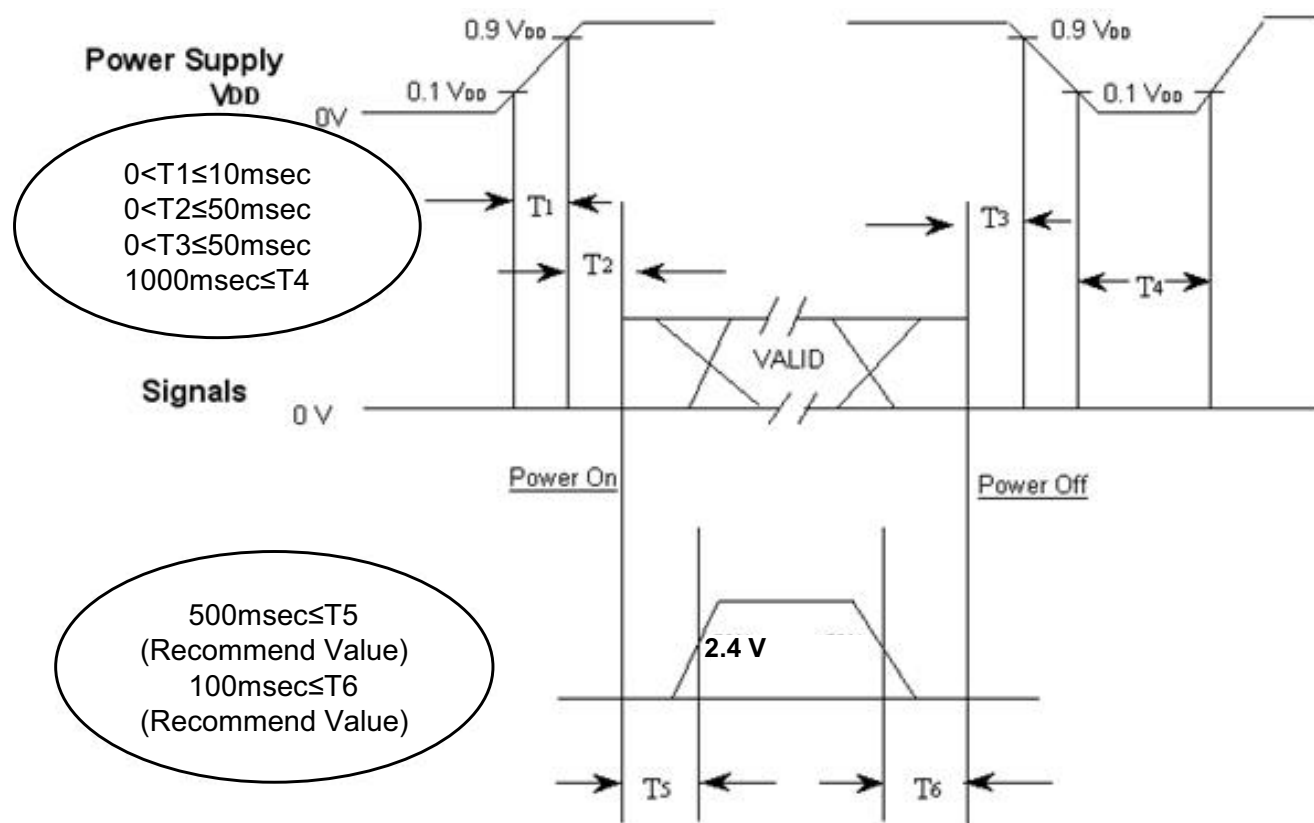| MODEL	LTI460HN04	Doc. No	05-000-GV-120220	Page	18/29

6.2 Timing diagrams of interface signal (DE mode)

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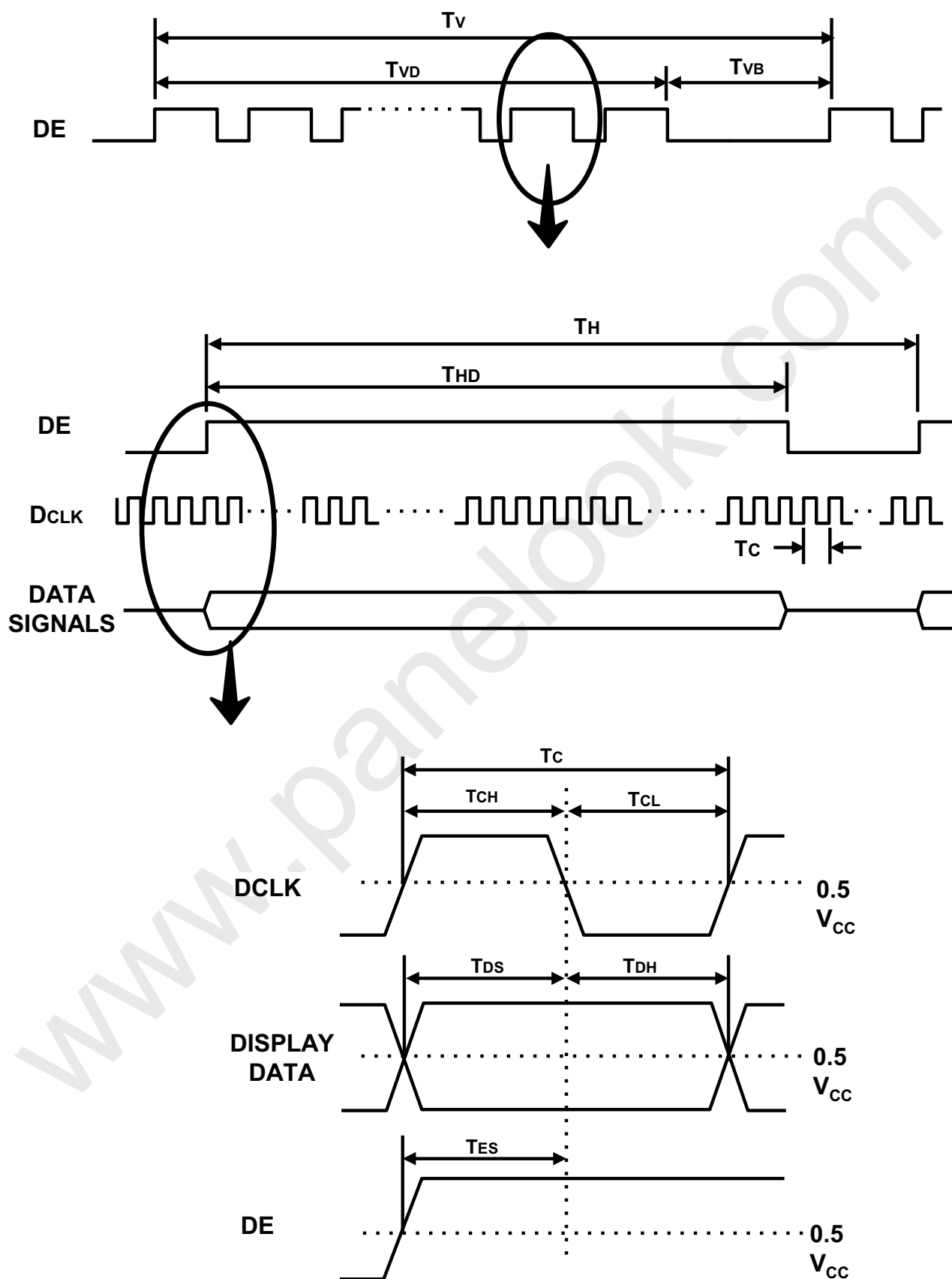
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6.3 Power ON/OFF Sequence

To prevent a latch-up or DC operation of the LCD Module, the power on/off sequence should be as the diagram below.

0<T1≤10msec
0<T2≤50msec
0<T3≤50msec
1000msec≤T4

500msec≤T5
(Recommend Value)
100msec≤T6
(Recommend Value)

T1 : V_{DD} rising time from 10% to 90%
T2 : The time from V_{DD} to valid data at power ON.
T3 : The time from valid data off to V_{DD} off at power Off.
T4 : V_{DD} off time for Windows restart
T5 : The time from valid data to B/L enable at power ON.
T6 : The time from valid data off to B/L disable at power Off.

- The supply voltage of the external system for the Module input should be the same as the definition of V_{DD}.
- Apply the lamp voltage within the LCD operation range. When the backlight turns on before the LCD operation or the LCD turns off before the backlight turns off, the display may momentarily show abnormal screen.
- In case of V_{DD} = off level, please keep the level of input signals low or keep a high impedance.
- T4 should be measured after the Module has been fully discharged between power off and on period.
- Interface signal should not be kept at high impedance when the power is on.

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7. Outline Dimension (Front View)

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7. Outline Dimension (Rear View)

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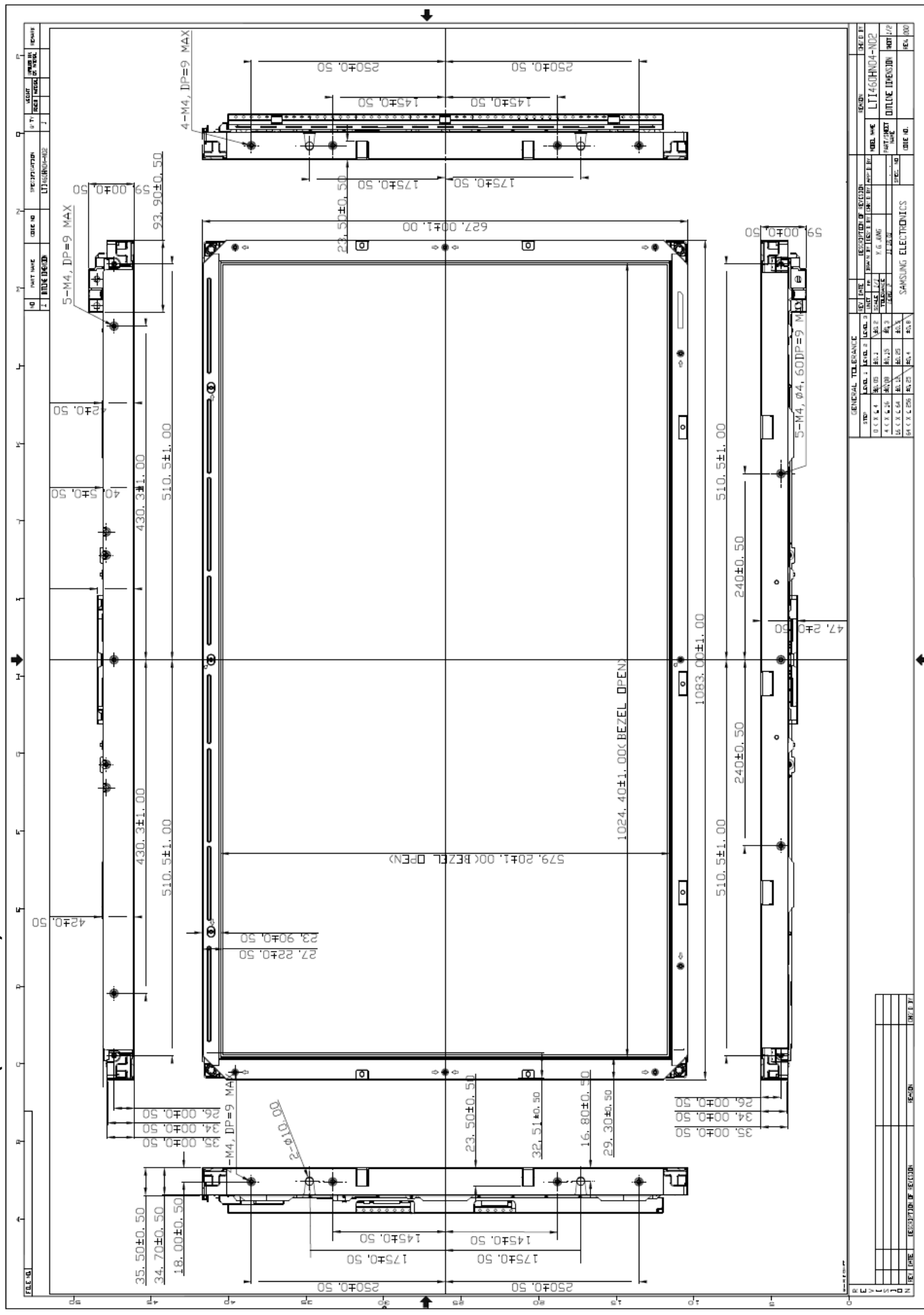
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8. Reliability Test

Item	Test condition	Quantity
HTOL	50℃, 500hr determination	8EA
LTOL	0℃, 500hr determination	4EA
HTS	70℃, 500hr determination	4EA
LTS	-20℃, 500hr determination	4EA
THB	50℃ / 80%RH, 500hr determination	4EA
WHTS	60℃ / 75%RH, 500hr determination	4EA
T/S	-20 ~ 60℃, Dwell time : 30Min, 100cycle	4EA
TSS	-20 ~ 65℃, 220cycle	4EA
Image sticking	50℃, Mosaic pattern (9X10), 168hrs	4EA
Contact ESD	±10 kV ,150pF/330Ω, 210Point, 1 time/Point	3EA
Air ESD	±20 kV, 150pF/100Ω, 210Point, 1 time/Point	3EA
Input Con. ESD	±15kV, 150pF/330Ω, Input Con. Pin, 3 times/Pin	3EA
Vibration	10 ~ 300Hz, 1.5G, 10minSR, 30min/±XYZ axis	3EA
Shock	1time/±XY axis 40G, ±Z axis 30G, 11msec	3EA
Dust	JIS 8types(6.6 ~ 8.6um) 50g, Carbon black(20nm) 4g, 5sec spray, 5min sedimentation / 5hr, Power 10min on, 10min off	2EA
Pallet Vibration → Pallet Drop	Pallet vibration : 1.05Grms, 5 ~ 200Hz, 2hr/stack side Pallet Drop : 20cm, bottom side 2 angles, 1side(Bottom)	1Pallet
Altitude	-40~50℃, 0m(0ft)~13,700m(45,000ft), 72.5Hr	4EA
Twist	10˚, 0.7s/times, 1000times	4EA

[Result Evaluation Criteria]
Under the display quality test conditions with normal operation state, these should be no change which may affect practical display functions.

```
 *   HTOL/ LTOL  : High/Low  Temperature Operating Life
 **  THB          : Temperature Humidity Bias
 *** HTS/LTS     : High/Low Temperature Storage
 **** WHTS        : Wet High Temperature Storage
```
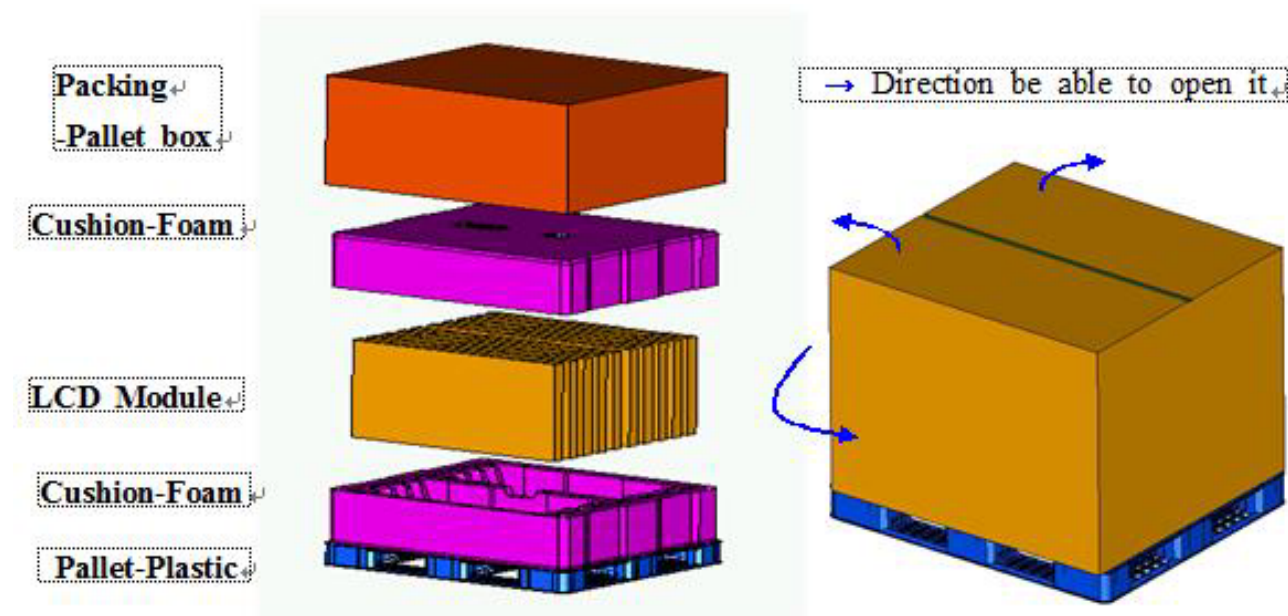
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9. PACKING

9.1 CARTON (Internal Package)

(1) Packing Form
   Corrugated fiberboard box and corrugated cardboard as shock absorber

(2) Packing Method

Packing-Pallet box
Cushion-Foam
LCD Module
Cushion-Foam
Pallet-Plastic

→ Direction be able to open it

9.2 Packing Specification

Item	Specification	Remark
LCD Packing	10 ea / (Packing-Pallet Box)	1. 125 kg / LCD (10ea) 2. 10 Kg / Cushion-Foam (2ea) 2. 8 Kg / Packing-Pallet Box (1ea) >. Cushion-Foam Material : EPS >. Packing-Pallet Box Material : DW4
Pallet	1Box / Pallet	1. Pallet weight = 8.8 kg 2. 8.8kg / Pallet
Packing Direction	Vertical	
Total Pallet Size	H x V x height	1270mm(H) x 1150mm(V) x 844mm(height)
Total Pallet Weight	151.8 kg	Pallet(8.8kg) + Module (125 kg) + Pallet-Cushion(10Kg) + Pallet-BOX(8kg)

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9.3 Packing Storage condition

ITEM	Unit	Min.	Max.
Storage Temperature	(℃)	5	40
Storage Humidity	(%rH)	35	75
Storage life	12 months		
Storage Condition	- The storage room should provide good ventilation and temperature control. - Products should not be placed on the floor, but on the Pallet away from a wall. - Prevent products from direct sunlight, moisture nor water; Be cautious of a build up of condensation. - Avoid other hazardous environment while storing goods. - If products delivered or kept in conditions of over the storage period of 3 months, the recommended temperature or humidity range, we recommend you leave them at a temperature of 20℃ and a humidity of 50% for 24 hours.		

9.4 Packing long-term Storage guide

Long –term Storage Process	More than 3months Storage or Low temp. Delivery/under 5℃ Storage → On the 20℃ 50%rH Condition, More than 10hrs release.

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10. MARKING & OTHERS

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A nameplate bearing followed by is affixed to a shipped product at the specified location on each product.

(1) Part number : LTI460HN04
(2) Revision: Three letters
(3) Lot number : X X X X XXX XX X

- Cell Position No. (In the Glass)
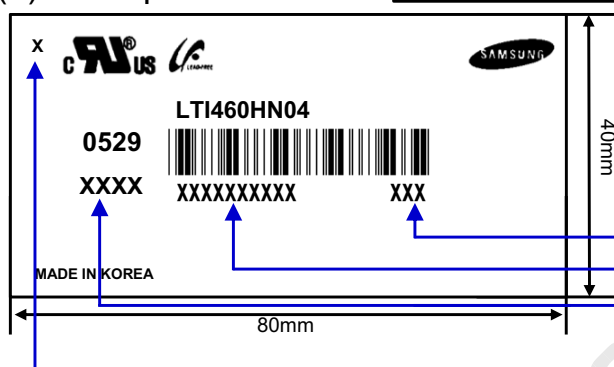- Glass No. (In the one Lot)
- Lot No. (Glass)
- Month
- Year (Note1)
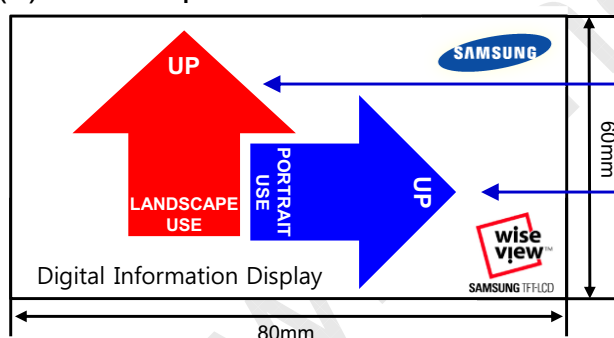- Product code
- Line

(4) Nameplate Indication

X
LTI460HN04
0529
XXXX   XXXXXXXXXX   XXX
MADE IN KOREA
80mm
40mm

Week code : 05 29
- week
- year

Revision code
Lot number
FAB code
Module site

(5) Landscape / Portrait Direction Indication

UP
LANDSCAPE USE
PORTRAIT USE
UP
Digital Information Display
wise view
SAMSUNG TFT-LCD
80mm
60mm

Landscape

Portrait

(6) Packing box attach

DVC： **LTI460HN04**
TYPE： XXXX
QTY： 10
XXXXXXXXXX
165mm
100mm
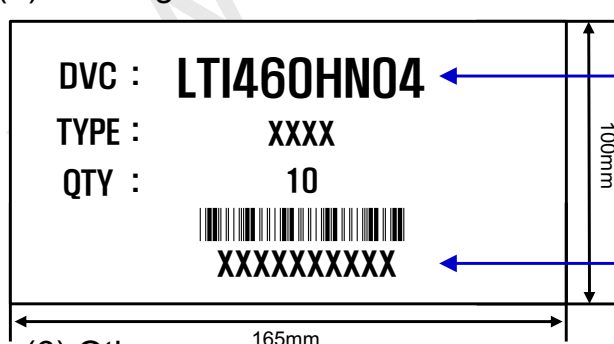
Part number

Box serial number

(6) Others
1. After service part
   Lamps cannot be replaced because of the narrow bezel structure.

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11. General Precautions

11.1 Handling

(a) When the Module is assembled, it should be attached to the system firmly
    using all mounting holes. Be careful not to twist and bend the Module.

(b) Because the inverter use high voltage, it should be disconnected from power
    before it is assembled or disassembled.

(c) Refrain from strong mechanical shock and / or any force to the Module.
    In addition to damage, this may cause improper operation or damage to the Module
    and CCFT back light.

(d) Note that polarizers are very fragile and could be damage easily.
    Do not press or scratch the surface harder than a HB pencil lead.

(e) Wipe off water droplets or oil immediately. If you leave the droplets for a long
    time, staining or discoloration may occur.

(f) If the surface of the polarizer is dirty, clean it using absorbent cotton or soft cloth.

(g) Desirable cleaners are water, IPA(Isopropyl Alcohol) or Hexane.
    Do not use Ketone type materials(ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid
    or Methyl chloride. It might permanent damage to the polarizer due to chemical
    reaction.

(h) If the liquid crystal material leaks from the panel, it should be kept away
    from the eyes or mouth . In case of contact with hands, legs or clothes, it must
    be washed away with soap thoroughly.

(i) Protect the module from Electrostatic discharge. Otherwise the ASIC IC or
    semiconductor would be damaged.

(j) Use finger-stalls with soft gloves in order to keep display clean during the
    incoming inspection and assembly process.

(k) Do not disassemble the Module.

(l) Do not disassemble shield case of inverter & LVDS board

(m) Do not connect N.C pins. (Samsung internal use only)

(n) Protection film for polarizer on the Module should be slowly peeled off just before use
    so that the electrostatic charge can be minimized. Must put on antistatic glove while
    handling a module

(o) Pins of I/F connector should not be touched directly with bare hands.

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11.2 Storage

(a) Do not leave the Module in high temperature, and high humidity for a long time.
It is highly recommended to store the Module with temperature from 0 to 35℃
and relative humidity of less than 70%.

(b) Do not store the TFT-LCD Module in direct sunlight.

(c) The Module should be stored in a dark place. It is prohibited to apply sunlight or
fluorescent light in storing.

11.3 Operation

(a) Do not connect or disconnect the Module in the "Power On" condition.

(b) Power supply should always be turned on/off by the "Power on/off sequence"

(c) Module has high frequency circuits. Sufficient suppression to the electromagnetic
interference should be done by system manufacturers.
Grounding and shielding methods may be important to minimize the interference.

(d) The cable between the backlight connector and its inverter power supply should
be connected directly with a minimized length. A longer cable between the backlight
and the inverter may cause lower luminance of lamp(CCFT) and may require
higher startup voltage(Vs).

11.4 Operation Condition Guide

(a) The LCD product should be operated under normal conditions.
Normal condition is defined as below;
- Temperature : 20±15℃
- Humidity : 55±20%
- Display pattern : continually changing pattern (Not stationary)

(b) If the product will be used in extreme conditions such as high temperature,
humidity, display patterns or operation time etc.., It is strongly recommended
to contact SEC for Application engineering advice. Otherwise, its reliability and
function may not be guaranteed. Extreme conditions are commonly found at
Airports, Transit Stations, Banks, Stock market, and Controlling systems.

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11.5 Others

(a) Ultra-violet ray filter is necessary for outdoor operation.

(b) Module should be turned clockwise (regular front view perspective) when used in portrait mode

(c) Avoid condensation of water. It may result in improper operation or disconnection of electrode.

(d) Do not exceed the absolute maximum rating value. (supply voltage variation, input voltage variation, variation in part contents and environmental temperature, and so on)
Otherwise the Module may be damaged.

(e) If the Module keeps displaying the same pattern for a long period of time, the image may be "sticked" to the screen.
To avoid image sticking, it is recommended to use a screen saver.

(f) This Module has its circuitry PCB's on the rear side and should be handled carefully in order not to be stressed.

(g) Please contact SEC in advance when you display the same pattern for a long time.

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